Low cost, Lightweight, FeS2-Based Photovoltaic Devices by On Demand Ink Jet Printing

Completed Technology Project (2012 - 2016)

Project Introduction

This research projects seeks to develop novel synthesis for iron pyrite, FeS2, nanocrystals and nanorods. The synthesis of the material includes investigating the effects of size, shape, doping and precise stoichiometry on the optical and electrical properties of the product, as FeS2 has the potential to be a low-cost, non-toxic, light weight, highly absorbing material for use in photovoltaics. The second objective of this research is to develop a quick, facile ink-jet printing (IJP) system to precisely deposit the synthesized nanomaterials in ambient conditions. Finally, after optimizing both synthesis and deposition of the material, this project proposes an investigation of potential photovoltaic device designs; evaluating the impact of multi-junctions, doping, and multiple exciton generation with FeS2 based materials on the voltage output of photovoltaics. Overall, the FeS2 material will be made through a variety of chemical synthesis routes, initially under inert atmospheres, but investigation will be done into syntheses under ambient conditions. First, the FeS2 nanomaterial will be created through the pyrolytic decomposition of a Fe-ligand precursor in the presence of a sulfur compound. By selectively decomposing the tri-ligated metal precursor, we believe that we can direct the self-assembly between nanocrystals and nanorods. Size of the nanomaterials is also controlled through the precursor selection and treatment. We also plan to create a novel Fe-S thiocarboxyalic acid precursor to create the FeS2 nanomaterial. Any doping of material will take place during the chemical synthesis by adding a dopant-containing precursor. Once the FeS2 nanomaterial has been created, optimized and characterized, it will be deposited by an ink jet printer to create a prototype solar cell. This work will potentially create both a low-cost nanomaterial for solar energy capture, but also a low-cost method for fabricating solar cells that expands beyond this particular material. Supporting this work will allow development of a skilled researcher, a leader in the photovoltaics industry. Solar energy conversion is an area of work that is vital to NASA space missions and beyond. Lower-cost, lighter weight and durable photovoltaics are necessary to decrease spacecraft weight, allowing for increased exploration of the surrounding universe, making space for cutting-edge science instruments. Investing in solar energy technology for space applications can easily transfer to improved materials and device fabrication for earth-based solar cells, aligning with NASAs mission to benefit all mankind through scientific discovery.

Anticipated Benefits

This work will potentially create both a low-cost nanomaterial for solar energy capture, but also a low-cost method for fabricating solar cells that expands beyond this particular material. Solar energy conversion is an area of work that is vital to NASA space missions and beyond. Lower-cost, lighter weight and durable photovoltaics are necessary to decrease spacecraft weight, allowing for increased exploration of the surrounding universe, making space for cutting-edge science instruments. Investing in solar energy technology for

Project Image Low Cost, Lightweight, FeS2-based Photovoltaic Devices by on Demand Ink Jet Printing

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Space Technology Research Grants

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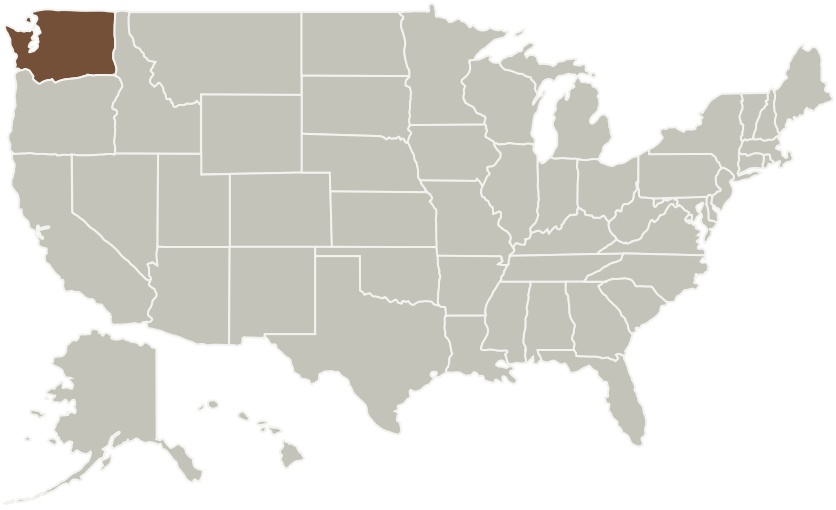
Primary U.S. Work Locations and Key Partners



Primary U.S. Work Locations
Washington

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

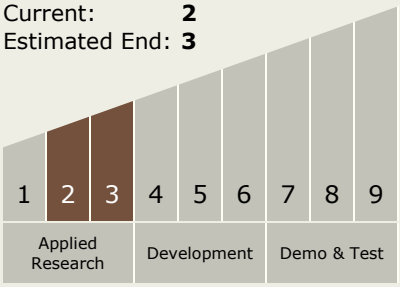
Kannan Krishnan

Co-Investigator:

Olivia Lenz

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.6 Materials for Electrical Power Generation, Energy Storage, Power Distribution and Electrical Machines

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Images

11520-1363187945674.jpg
Project Image Low Cost, Lightweight, FeS2-based Photovoltaic Devices by on Demand Ink Jet Printing
(https://techport.nasa.gov/image/1788)

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html